IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF ENVIRONMENTAL PROTECTION, STATE OF CONNECTICUT, STATE OF MARYLAND, STATE OF NEW JERSEY, and STATE OF NEW YORK, Plaintiffs, v. ALLEGHENY ENERGY, INC., ALLEGHENY ENERGY SERVICE CORPORATION, ALLEGHENY ENERGY SUPPLY COMPANY, LLC, MONONGAHELA POWER COMPANY, THE POTOMAC EDISON COMPANY, and WEST PENN POWER COMPANY, Defendants.	Civil Action No. 2:05cv0885 Judge Terrence F. McVerry Magistrate Judge Robert C. Mitchell

ATTACHMENT D
PART 2

optimal hindsight coverage would have compared in costs to a proposed restructuring of the obligation. He also reviewed the prudence of prior, actual coverage of the obligation in light of conventional risk management practices and prevailing market conditions of credit constraints and low long-term liquidity.

- Several banks have been accused of aiding and abetting Enron's fraudulent schemes and have been sued for damages. Mr. Graves analyzed how the stock market had reacted to one bank's equity-analyst reports endorsing Enron as a "buy," to determine if those reports induced statistically significant positive abnormal returns. He showed that individually and collectively they did not have such an effect. Testimony was presented.

- Mr. Graves lead an analysis of whether a corporate subsidiary had been effectively under the strategic and operational control of its parent, to such an extent that it was appropriate to "pierce the corporate veil" of limited liability. The analysis investigated the presence of untenable debt capitalization in the subsidiary, overlapping management staff, the adherence to normal corporate governance protocols, and other kinds of evidence of excessive parental control.

- As a tax-revenue enhancement measure, the IRS was considering a plan to recapture deferred taxes associated with generation assets that were divested or reorganized during state restructurings for retail access. Mr. Graves prepared a white paper demonstrating the unfairness and adverse consequences of such a plan, which was instrumental in eliminating the proposal.

- In a dispute over damages from a prematurely terminated long-term power tolling contract, Mr. Graves presented evidence on why calculating the present value of those damages required the use of two distinct discount rates: one (a low rate) for the revenues lost under the low-risk terminated contract and another, much higher rate, for the valuation of the replacement revenues in the risky, short-term wholesale power markets. The amount of damages was dramatically larger under a two-discount rate calculation, which was the position adopted by the court.

- The energy and telecom industries have been plagued by allegations regarding trading and accounting misrepresentations, such as wash trades, manipulations of mark-to-market valuations, premature recognition of revenues, and improper use of off-balance sheet entities. In many cases, this conduct has preceded financial collapse and subsequent shareholder suits. Mr. Graves lead research on accounting and financial evidence, including event studies of the stock price movements around the time of the contested practices, and reconstruction of accounting and economic justifications for the way asset values and revenues were recorded.

- Dramatic natural gas price increases in the U.S. have put several natural gas and electric utilities in the position of having to counter claims that they should have hedged more of their fuel supplies at times in the past. Mr. Graves developed testimony to rebut this hindsight criticism and risk management techniques for fuel (and power) procurement for utilities to apply in the future to avoid prudence challenges.

- As a means of calculating its stranded costs, a utility used a partial spin-off of its generation assets to a company that had a minority ownership from public shareholders. A dispute arose as to whether this minority ownership might be depressing the stock price, if a "control premium" was being implicitly deducted from its value. Using event studies and structural analyses, Mr. Graves identified the key drivers of value for this partially spun-off subsidiary, and he showed that value was not being impaired by the operating, financial and strategic restrictions on the company. He also reviewed the financial economics literature on empirical evidence for control premiums, which he showed reinforced the view that no control premium de-valuation was likely to be affecting the stock.

- A large public power agency was concerned about its debt capacity in light of increasing competitive pressures to allow its resale customers to use alternative suppliers. Mr. Graves lead a team that developed an Economic Balance Sheet representation of the agency's electric assets and liabilities in market value terms, which was analyzed across several scenarios to determine safe levels of debt financing. In addition, new service pricing and upstream supply contracting arrangements were identified to help reduce risks.

- Wholesale generating companies intuitively realize that there are considerable differences in the financial risk of different kinds of power plant projects, depending on fuel type, length and duration of power purchase agreements, and tightness of local markets. However, they often are unaware of how if at all to adjust the hurdle rates applied to valuation and development decisions. Mr. Graves lead a Brattle analysis of risk-adjusted discount rates for generation; very substantial adjustments were found to be necessary.

- A major telecommunications firm was concerned about when and how to reenter the Pacific Rim for wireless ventures following the economic collapse of that region in 1997-99. Mr. Graves lead an engagement to identify prospective local partners with a governance structure that made it unlikely for them to divert capital from the venture if markets went soft. He also helped specify contracting and financing structures that create incentives for the venture to remain together should it face financial distress, while offering strong returns under good performance.

- There are many risks associated with operations in a foreign country, related to the stability of its currency, its macro economy, its foreign investment policies, and even its political system. Mr. Graves has assisted firms facing these new dimensions to assess the risks, identify strategic advantages, and choose an appropriate, risk-adjusted hurdle rate for the market conditions and contracting terms they will face.

- The glut of generation capacity that helped usher in electric industry restructuring in the US led to asset devaluations in many places, even where no retail access was allowed. In some cases, this has led to bankruptcy, especially of a few large rural electric cooperatives. Mr. Graves assisted one such coop with its long term financial modeling and rate design under its plan of reorganization, which was approved. Testimony was provided on cost-of-service justifications for the new generation and transmission prices, as well as on risks to the plan from potential environmental liabilities.

- Power plants often provide a significant contribution to the property tax revenues of the townships where they are located. A common valuation policy for such assets has been that they are worth at least their book value, because that is the foundation for their cost recovery under cost-of-service utility ratemaking. However, restructuring throws away that guarantee,

requiring reappraisal of these assets. Traditional valuation methods, *e.g.*, based on the replacement costs of comparable assets, can be misleading because they do not consider market conditions. Mr. Graves testified on such matters on behalf of the owners of a small, out-of-market coal unit in Massachusetts.

- Stranded costs and out-of-market contracts from restructuring can affect municipalities and cooperatives as well as investor-owned utilities. Mr. Graves assisted one debt-financed utility in an evaluation of its possibilities for reorganization, refinancing, and re-engineering to improve financial health and to lower rates. Sale and leaseback of generation, fuel contract renegotiation, targeted downsizing, spin-off of transmission, and new marketing programs were among the many components of the proposed new business plan.

- As a means of reducing supply commitment risk, some utilities have solicited offers for power contracts that grant the right but not the obligation to take power at some future date at a predetermined price, in exchange for an initial option premium payment. Mr. Graves assisted several of these utilities in the development of valuation models for comparing the asking prices to fair market values for option contracts. In addition, he has helped these clients develop estimates of the critical option valuation parameters, such as trend, volatility, and correlations of the future prices of electric power and the various fuel indexes proposed for pricing the optional power.

- For the World Bank and several investor-owned electric utilities, Mr. Graves presented tutorial seminars on applying methods of financial economics to the evaluation of power production investments. Techniques for using option pricing to appraise the value of flexibility (such as arises from fuel switching capability or small plant size) were emphasized. He has applied these methods in estimating the value of contingent contract terms in fuel contracts (such as price caps and floors) for natural gas pipelines.

- Mr. Graves prepared a review of empirical evidence regarding the stock market's reaction to alternative dividend, stock repurchase, and stock dividend policies for a major electric utility. Tax effects, clientele shifting, signaling, and ability to sustain any new policies into the future were evaluated. A one-

time stock repurchase, with careful announcement wording, was recommended.

- For a division of a large telecommunications firm, Mr. Graves assisted in a cost benchmarking study, in which the costs and management processes for billing, service order and inventory, and software development were compared to the practices of other affiliates and competitors. Unit costs were developed at a level far more detailed than the company normally tracked, and numerical measures of drivers that explained the structural and efficiency causes of variation in cost performance were identified. Potential costs savings of 10-50 percent were estimated, and procedures for better identification of inefficiencies were suggested.

- For an electric utility seeking to improve its plant maintenance program, Mr. Graves directed a study on the incremental value of a percentage point decrease in the expected forced outage rate at each plant owned and operated by the company. This defined an economic priority ladder for efforts to reduce outage that could be used in lieu of engineering standards for each plant's availability. The potential savings were compared to the costs of alternative schedules and contracting policies for preventive and reactive maintenance, in order to specify a cost reduction program.

- Mr. Graves conducted a study on the risk-adjusted discount rate appropriate to a publicly-owned electric utility's capacity planning. Since revenue requirements (the amounts being discounted) include operating costs in addition to capital recovery costs, the weighted average cost of capital for a comparable utility with traded securities may not be the correct rate for every alternative or scenario. The risks implicit in the utility's expansion alternatives were broken into component sources and phases, weighted, and compared to the risks of bonds and stocks to estimate project-specific discount rates and their probable bounds.

Regulated Industry Restructuring

- Many utilities experienced significant "rate shock" when they recently ended "rate freeze" periods that had been implemented with earlier retail restructuring. The adverse customer and political reactions have lead to

proposals to annual procurement auctions and to return to utility-owned or managed supply portfolios. Mr. Graves has assisted utilities and wholesale gencos with analyses of whether alternative supply procurement arrangements could be beneficial.

- As a result of vertical unbundling, many utilities must procure a substantial portion of their power from resources they do not own or operate. Market prices for such supplies are quite volatile. In addition, utilities may face future customer switching to or from their supply service, especially if they are acting as provider of last resort (POLR). This problem is a blending of risk management with the traditional least-cost Integrated Resource Planning (IRP). Regulatory standards for findings of prudence in such a hybrid environment are often not well understood or articulated, leaving utilities at risk for cost disallowances that can jeopardize their credit-worthiness. Mr. Graves has assisted several utilities in devising updated procurement mechanisms and associated regulatory guidelines that clarify the conditions for approval of plans, in order to make possible the expedited procurement of power from wholesale market suppliers.

- There is a strong tendency in electric restructuring to impose "provider of last resort" (POLR) transitional supply obligations on the incumbent distribution companies. Unfortunately, POLR obligations that are extremely protective of customers harm the development of competitive retail power markets and can impose extreme, viability-threatening costs or risks on distcos. Mr. Graves developed policy papers and tutorials on this problem for the Edison Electric Institute, and advised several utilities on the design and valuation of alternative POLR specifications and coverage strategies.

- Public power authorities and cooperatives face risks from wholesale restructuring if their sales-for-resale customers are free to switch to or from supply contracting with other wholesale suppliers. Such switching can create difficulties in servicing the significant debt capitalization of these public power entities, as well as equitable problems with respect to non-switching customers. Mr. Graves has lead analyses of this problem, and has designed alternative product pricing, switching terms and conditions, and debt capitalization policies to cope with the risks.

- As a means of unbundling to retain ownership but not control of generation, some utilities turned to divesting output contracts. Mr. Graves was involved in the design and approval of such agreements for an entire fleet of generation. The work entailed estimating and projecting cost functions that were likely to track the future marginal and total costs of the units, and analysis of the financial risks the plant operator would bear from the output pricing formula. Testimony on risks under this form of restructuring was presented.

- Mr. Graves worked with the executive committees of several utilities in designing regulatory strategies for influencing the pace and procedures associated with the transition to retail electric access. These included comprehensive business strategies and integrated planning tools for service unbundling and pricing, incentive ratemaking, corporate reorganization, market forecasting, asset valuation, and risk management.

- Mr. Graves contributed to the design and pricing of unbundled services on several natural gas pipelines. To identify attractive alternatives, the marginal costs of possible changes in a pipeline's service mix were quantified by simulating the least-cost operating practices subject to the network's physical and contractual constraints. Such analysis helped one pipeline to justify a zone-based rate design for its firm transportation service. Another pipeline used this technique to demonstrate that unintended degradations of system performance and increased costs could ensue from certain proposed unbundlings that were insensitive to system operations.

- For several natural gas pipeline companies, Mr. Graves evaluated the cost of equity capital in light of the requirements of FERC Order 636 to unbundle and reprice pipeline services. In addition to traditional DCF and risk positioning studies, the risk implications of different degrees of financial leverage (debt capitalization) were modeled and quantified. Aspects of rate design and cost allocation between services that also affect pipeline risk were considered.

- Mr. Graves assisted several utilities in forecasting market prices, revenues, and risks for generation assets being shifted from regulated cost recovery to competitive, deregulated wholesale power markets. Such studies have facilitated planning decisions, such as whether to divest generation or retain it, and have been used as the basis for quantifying stranded costs associated with restructuring in regulatory hearings. Mr. Graves' work in this area has helped

several utilities develop long term planning models for managing their generation assets in a competitive market. Mr. Graves has assisted a leasing company with analyses of the tax-legitimacy of complex leasing transactions by reviewing the extent and quality of due diligence pursued by the lessor, the adequacy of pre-tax returns, the character, time pattern, and degree of risk borne by the buyer (lessor), the extent of defeasance, and compliance with prevailing guidelines for true-lease status.

Market Competition

- Regulatory and legal approvals of utility mergers require evidence that the combined entity will not have undue market power. Mr. Graves assisted several utilities in evaluating the competitive impacts of potential mergers and acquisitions. He has identified ways in which transmission constraints reduce the number and type of suppliers, along with mechanisms for incorporating physical flow limits in FERC Delivered Price Test (DPT) for mergers. He has also assessed the adequacy of mitigation measures (divestitures and conduct restrictions) under the DPT, Market-Based Rates, and other tests of potential market power arising from proposed mergers.

- A major concern associated with electric utility industry restructuring is whether or not generation markets are adequately competitive. Because of the state-dependent nature of transmission transfer capability between regions, itself a function of generation use, the quality of competition in the wholesale generation markets can vary significantly and may be susceptible to market power abuse by dominant suppliers. Mr. Graves helped one of the largest ISOs in the U.S. develop market monitoring procedures to detect and discourage market manipulations that would impair competition.

- Vertical market power arises when sufficient control of an upstream market creates a competitive advantage in a downstream market. It is possible for this problem to arise in power supply, in settings where the likely marginal generation is dependent on very few fuel suppliers who also have economic interests in the local generation market. Mr. Graves analyzed this problem in the context of the California gas and electric markets and filed testimony to explain the magnitude and manifestations of the problem.

- The increased use of transmission congestion pricing has created interest in merchant transmission facilities. Mr. Graves assisted a developer with

testimony on the potential impacts of a proposed line on market competition for transmission services and adjacent generation markets. He also assisted in the design of the process for soliciting and ranking bids to buy tranches of capacity over the line.

- Many regions have misgivings about whether the preconditions for retail electric access are truly in place. In one such region, Mr. Graves assisted a group of industrial customers with a critique of retail restructuring proposals to demonstrate that the locally weak transmission grid made adequate competition among numerous generation suppliers very implausible.

- Mr. Graves assisted one of the early ISOs with its initial market performance assessment and its design of market monitoring tests for diagnosing the quality of prevailing competition.

Utility Planning and Operations

- The potential introduction of environmental restrictions or fees for CO_2 emissions has made generation expansion decisions much more complex and risky. Mr. Graves helped one utility assess these risks in regard to a planned baseload coal plant, finding that the value of flexibility in other technologies was high enough to prefer not building a conventional coal plant.

- Mr. Graves has helped design, implement, and gain regulatory approvals for a natural gas procurement hedging program for a western U.S. gas and electric utility. A model of how gas forward prices evolve over time was estimated and combined with a statistical model of the term structure of gas volatility to simulate the uncertainty in the annual cost of gas at various times during its procurement.

- Generation planning for utilities has become very complex and risky due to high natural gas prices and potential CO2 restrictions of emission allowances. Some of the scenarios that must be considered would radically alter system operations relative to current patterns of use. Mr. Graves has assisted utilities with long range planning for how to measure and cope with these risks, including what kinds of regulatory communications to pursue to manage expectations in this difficult environment.

- Several utilities with coal-fired power plants have faced allegations from the U.S. EPA that they have conducted past maintenance on these plants which should be deemed "major modifications", thereby triggering New Source Review standards for air quality controls. Mr. Graves has helped one such utility assess limitations on the way in which GADS data can be used retrospectively to quantify comparisons between past actual and projected future emissions. For another utility, Mr. Graves developed retrospective estimates of changes in emissions before and after repairs using production costing simulations. In a third, he reviewed contemporaneous corporate planning documents to show that no increase in emissions would have been expected from the repairs, due to projected reductions in future use of the plant as well as higher efficiency. In all three cases, testimony was presented.

- The U.S. Government is contractually obligated to dispose of spent nuclear fuel at commercial reactors after January 1998, but it has not fulfilled this duty. As a result, nuclear facilities that are shutdown or facing full spent fuel pools are facing burdensome costs and risks. Mr. Graves prepared testimony on the incremental costs being borne by three nuclear operating companies with shutdown units as a result of this federal failure to perform.

- Capturing the full value of hydroelectric generation assets in a competitive power market is heavily dependent on operating practices that astutely shift between real power and ancillary services markets, while still observing a host of non-electric hydrological constraints. Mr. Graves led studies for several major hydro generation owners in regard to forecasting of market conditions and corresponding hydro schedule optimization. He has also designed transfer pricing procedures that create an internal market for diverting hydro assets from real power to system support services firms that do not yet have explicit, observable market prices.
- The impacts of transmission open access and generation competition on utility financial health are well documented. In addition, there substantial impacts on fuel suppliers, due to revised dispatch, repowerings and retirements, changes in expansion mix, and altered load shapes and load growth under more competitive pricing. For EPRI, Mr. Graves contributed to a study that projected changes in fuel use within and between ten large power market regions spanning the country under different scenarios for the pace and success of restructuring.

- Mr. Graves led a gas distribution company in the development of an incentive ratemaking system to replace all aspects of its traditional cost of service

regulation. The base rates (for non-fuel operating and capital costs) were indexed on a price-cap basis (RPI-X), while the gas and upstream transportation costs allowances were tied to optimal average annual usage of a reference portfolio of supply and transportation contracts. The gas program also included numerous adjustments to the gas company's rate design, such as designing new standby rates so that customer choice will not be distorted by pricing inefficiencies.

- An electric utility with several out-of-market independent power contracts wanted to determine the value of making those plants dispatchable and to devise a negotiating strategy for restructuring the IPP agreements. Mr. Graves developed a range of forecasts for the delivered price of natural gas to this area of the country. Alternative ways of sharing the potential dispatch savings were proposed as incentives for the IPPs to renegotiate their utility contracts.

- For an electric utility considering the conversion of some large oil-fired units to natural gas, Mr. Graves conducted a study of the advantages of alternative means of obtaining gas supplies and gas transportation services. A combination of monthly and daily spot gas supplies, interruptible pipeline transportation over several routes, gas storage services, and "swing" (contingent) supply contracts with gas marketers was shown to be attractive. Testimony was presented on why the additional services of a local distribution company would be unneeded and uneconomic.

- A power engineering firm entered into a contract to provide operations and maintenance services for a cogenerator, with incentives fees tied to the unit's availability and operating cost. When the fees increased due to changes in the electric utility tariff to which they were tied, a dispute arose. Mr. Graves provided analysis and testimony on the avoided costs associated with improved cogeneration performance under a variety of economic scenarios and under several alternative utility tariffs.

- Mr. Graves helped several pipelines design incentive pricing mechanisms for recovering their expected costs and reducing their regulatory burdens. Among these have been Automatic Rate Adjustment Mechanisms (ARAMs) for indexation of operations and maintenance expenses, construction-cost variance-sharing for routine capital expenditures that included a procedure for eliciting unbiased estimates of future costs, and market-based prices capped at replacement costs when near-term future expansion was an uncertain but probable need.

- For a major industrial gas user, he prepared a critique of the transportation balancing charges proposed by the local gas distribution company. Those charges were shown to be arbitrarily sensitive to the measurement period as well as to inconsistent attribution of storage versus replacement supply costs to imbalance volumes. The tariff design, a commodity charge on a per-cash-in/cash-out at spot market gas prices with penalties for very deep imbalances, or an incremental storage inventory and withdrawal capacity used on-peak, were shown to be cheaper, more efficient, and less complex to administer. This analysis helped the parties reach a settlement based on the cash-in/cash-out design.

- The Clean Air Act Amendment authorized electric utilities to trade emission allowances (EAs) as part of their approach to complying with SO_2 emissions reductions targets. For the Electric Power Research Institute (EPRI), Mr. Graves developed multi-stage planning models to illustrate how the considerable uncertainty surrounding future EA prices justifies waiting to invest in irreversible control technologies, such as scrubbers or SCRs, until the present value cost of such investments is significantly below that projected from relying on EAs.

- For an electric utility with a troubled nuclear plant, Mr. Graves presented testimony on the economic benefits likely to ensue from a major reorganization. The plant was to be spun off to a jointly-owned subsidiary that would sell available energy back to the original owner under a contract indexed to industry unit cost experience. This proposal afforded a considerable reduction of risk to ratepayers in exchange for a reasonable, but highly uncertain prospect of profits for new investors. Testimony compared the incentive benefits and potential conflicts under this arrangement to the outcomes foreseeable from more conventional incentive ratemaking arrangements.

- Mr. Graves helped design Gas Inventory Charge (GIC) tariffs for interstate pipelines seeking to reduce their risks of not recovering the full costs of multi-year gas supply contracts. The costs of holding supplies in anticipation of future, uncertain demand were evaluated with models of the pipeline's supply portfolio that reveal how many non-production costs (demand charges, take-or-pay penalties, reservation fees, or remarketing costs for released gas) would accrue under a range of demand scenarios. The expected present value of these costs provided a basis for the GIC tariff.

- Mr. Graves performed a review and critique of a state energy commission's assessment of regional natural gas and electric power markets in order to determine what kinds of pipeline expansion into the area was economic. A proposed facility under review for regulatory approval was found to depend strongly on uneconomic bypass of existing pipelines and LDCs. In testimony, modular expansion of existing pipelines was shown to have significantly lower costs and risks.

- For several electric utilities with generation capacity in excess of target reserve margins, Mr. Graves designed and supervised market analyses that compared the marginal operating costs of all power plants not needed to meet target reserves to the marginal costs for 50 to 100 neighboring utilities. These cost curves were then overlaid on the corresponding curve for the client utility to identify which neighbors were competitors and which were potential customers. The strength of their relative threat or attractiveness could be quantified by the present value of the product of the amount, duration, and differential cost of capacity that was displaceable by the client utility.

- Mr. Graves specified algorithms for the enhancement of the EPRI EGEAS generation expansion optimization model, to capture the first-order effects of financial and regulatory constraints on the preferred generation mix.

- For a major electric power wholesaler, Mr. Graves developed a framework for estimating how pricing policies affect the relative attractiveness of capacity expansion alternatives. Traditional cost-recovery pricing rules can significantly distort the choice between two otherwise equivalent capacity plans, if one includes a severe "front end load" while the other does not. Price-demand feedback loops in simulation models and quantification of consumer satisfaction measures were used to appraise the problem. This "value of service" framework was generalized for the Electric Power Research Institute.

- For a large gas and electric utility, Mr. Graves participated in coordinating and evaluating the design of a strategic and operational planning system. This included computer models of all aspects of utility operations, from demand forecasting through generation planning to financing and rate design. Efforts were split between technical contributions to model design and attention to organizational priorities and behavioral norms with which the system had to be compatible.

- For a major electronic and semiconductor firm, Mr. Graves critiqued and refined a proposed procedure for ranking the attractiveness of research and development projects. Aspects of risk peculiar to research projects were emphasized over the standards used for budgeting an already proven commercial venture.

- For an oil and gas exploration and production firm, Mr. Graves developed a framework for identifying what industry groups were most likely to be interested in natural gas supply contracts featuring atypical risk-sharing provisions. These provisions, such as price indexing or performance requirements contingent on market conditions, are a form of product differentiation for the producer, allowing it to obtain a price premium for the insurance-like services.

- For a natural gas distribution company, Mr. Graves established procedures for redefining customer classes and for repricing gas services according to customers' similarities in load shape, access to alternative gas supplies, expected growth, and need for reliability. In this manner, natural gas service was effectively differentiated into several products, each with price and risk appropriate to a specific market. Planning tools were developed for balancing gas portfolios to customer group demands.

- For a Midwestern electric utility, Mr. Graves extended a regulatory *pro forma* financial model to capture the contractual and tax implications of canceling and writing off a nuclear power plant in mid-construction. This possibility was then appraised relative to completion or substitution alternatives from the viewpoints of shareholders (market value of common equity) and ratepayers (present value of revenue requirements).
- For a corporate venture capital group, Mr. Graves conducted a market-risk assessment of investing in a gas exploration and production company with contracts to an interstate pipeline. The pipeline's market growth, competitive strength, alternative suppliers, and regulatory exposure were appraised to determine whether its future would support the purchase volumes needed to make the venture attractive.

- For a natural gas production and distribution company, he developed a strategic plan to integrate the company's functional policies and to reposition its operations for the next five years. Decision analysis concepts were combined with marginal cost estimation and financial *pro forma* simulation to

identify attractive and resilient alternatives. Recommendations included target markets, supply sources, capital budget constraints, rate design, and a planning system. A two-day planning conference was conducted with the client's executives to refine and internalize the strategy.

- For the New Mexico Public Service Commission, he analyzed the merits of a corporate reorganization of the major New Mexico gas production and distribution company. State ownership of the company as a large public utility was considered but rejected on concerns over efficiency and the burdening of performance risks onto state and local taxpayers.

Electric and Gas Transmission

- For a utility seeking FERC approval for the purchase of an affiliate's generating facility, Mr. Graves analyzed how transmission constraints affecting alternative supply resources altered their usefulness to the buyer.

- As part of a generation capacity planning study, he lead an analysis of how congestion premiums and discounts relative to locational marginal prices (LMPs) at load centers affected the attractiveness of different potential locations for new generation. At issue was whether the prevailing LMP differences would be stable over time, as new transmission facilities were completed, and whether new plants could exacerbate existing differentials and lead to degraded market value at other plants.

- Mr. Graves assisted a genco with its involvement in the negotiation and settlement of "regional through and out rates" (RTOR) that were to be abolished when MISO joined PJM. His team analyzed the distribution of cost impacts from several competing proposals, and they commented on administrative difficulties or advantages associated with each.

- For the electric utility regulatory commission of Colombia, S.A., Mr. Graves led a study to assess the inadequacies in the physical capabilities and economic incentives to manage voltages at adequate levels. The *Brattle* team developed minimum reactive power support obligations and supplement reactive power acquisition mechanisms for generators, transmission companies, and distribution companies.

- Mr. Graves conducted a cost-of-service analysis for the pricing of ancillary services provided by the New York Power Authority.

- On behalf of the Electric Power Research Institute (EPRI), Mr. Graves wrote a primer on how to define and measure the cost of electric utility transmission capacity for better planning, pricing, and regulatory policies. The text covers the basic electrical engineering of power circuits, utility practices to exploit transmission economies of scale, means of assuring system stability, economic dispatch subject to transmission constraints, and the estimation of marginal costs of transmission. The implications for a variety of policy issues are also discussed.

- The natural gas pipeline industry is wedged between competitive gas production and competitive resale of gas delivered to end users. In principle, the resulting basis differentials between locations around the pipeline ought to provide efficient usage and expansion signals, but traditional pricing rules prevent the pipeline companies from participating in the marginal value of their own services. Mr. Graves worked to develop alternative pricing mechanisms and service mixes for pipelines that would provide more dynamically efficient signals and incentives.

- Mr. Graves analyzed the spatial and temporal patterns of marginal costs on gas and electric utility transmission networks using optimization models of production costs and network flows. These results were used by one natural gas transmission company to design receipt-point-based transmission service tariffs, and by another to demonstrate the incremental costs and uneven distribution of impacts on customers that would result from a proposed unbundling of services.

PROFESSIONAL MEMBERSHIPS

IEEE Power Engineering Society
Mathematical Association of America
American Finance Association
International Association for Energy Economics
Energy Modeling Forum (Stanford University)

EXPERT TESTIMONY

Direct testimony before the Public Service Commission of Maryland on behalf of Potomac Electric Power Company and Delmarva Power & Light Company, Case No. 9117, September 14, 2007, regarding portfolio management alternatives for supplying Standard Offer Service.

Direct testimony before the Arizona Commerce Commission on behalf of New West Energy Corporation, Docket No. E-03964A-06-0168, August 31, 2007, in regard to preconditions for effective retail electric competition.

Expert witness report in the United States Court of Federal Claims (No. 04-106C), on behalf of plaintiff Dairyland Power Cooperative in regard to the Government's performance in accepting spent nuclear fuel under contractual obligations established in 1983.

Direct and rebuttal testimony before the Corporation Commission of the State of Oklahoma, Case No. PUD 200700012, January 17, 2007 and June 18, 2007, on behalf of Oklahoma Gas & Electric Company (OG&E) regarding the application of OG&E for an order of commission granting preapproval to construct Red Rock Generating Facility and authorizing a recovery rider.

Testimony in U.S. District Court of New York SI:04Cr733 (TPG), on behalf of defendant Mark Kaiser in regard to whether defendant's role in accounting misrepresentations could be reliably associated with losses to shareholders.

Rebuttal testimony before the Illinois Commerce Commission on behalf of Midwest Generation EME L.L.C. and Edison Mission Marketing and Trading, Docket Number 06-0800, April 6, 2007, on whether proposed benchmarks for evaluating the Illinois retail supply auctions are reasonable and useful.

Direct and rebuttal testimony before the United States District Court, Southern District of Texas, Houston Division, on behalf of the U.S. Department of Justice, Criminal Number H-03-217, September 12, 2006, on the shareholder impacts of Dynegy's Project Alpha for the sentencing of Jamie Olis.

Direct and rebuttal testimony before the Pennsylvania Public Utility Commission, Docket Nos. R-00061366 and R-00061367, August 24, 2006, on the need for POLR rate cap relief for Metropolitan Edison and Pennsylvania Electric, and the prudence of their past supply procurement for those obligations, on behalf of FirstEnergy Corp.

Direct testimony before the United States District Court, Southern District of Texas, Houston Division, on behalf of the Deutsche Bank Entities, Docket No. H-01-3624, February 2006, regarding Deutsche Bank Entities' opposition to Enron Corp's amended motion for class certification.

Expert report and rebuttal report before the United States Court of Federal Claims on behalf of Pacific Gas and Electric Company, Docket No. 04-0074C, into which has been consolidated No. 04-0075C, November 2005, regarding the non-performance of the U.S. Department of Energy in accepting spent nuclear fuel under the terms of its contract.

Direct testimony before the Illinois Commerce Commission on behalf of Midwest Generation EME, LLC, Docket No. 05-0159, June 8, 2005, regarding the appropriate load caps for a POLR auction.

Affidavit to the Federal Energy Regulatory Commission on behalf of Dominion Energy, Inc., Docket No. EC05-43-000, April 11, 2005, regarding unmitigated market power concerns arising from the Exelon – PSEG Merger.

Expert and rebuttal reports and oral testimonies before the American Arbitration Association on behalf of Liberty Electric Power, LLC, Case No. 70 198 4 00228 04, December 2004, regarding damages under termination of a long-term tolling contract.

Oral direct and rebuttal testimony before the United States Court of Federal Claims on behalf of Connecticut Yankee Atomic Power Company, Docket No. 98-154 C, July 2004 (direct) and August 2004 (rebuttal), regarding non-performance of the U.S. Department of Energy in accepting spent nuclear fuel under the terms of its contract.

Direct, supplemental and rebuttal testimony before the Public Service Commission of Wisconsin, on behalf of Wisconsin Public Service Corporation and Wisconsin Power and Light Company, Docket No. 05-EI-136, February 27, 2004 (direct), May 4, 2004 (supplemental) and May 28, 2004 (rebuttal) in regard to the benefits of the proposed sale of the Kewaunee nuclear power plant.

Direct and rebuttal testimony before the Public Utility Commission of Texas on behalf of CenterPoint Energy Houston Electric LLC, Reliant Energy Retail Services LLC, and Texas Genco LP, Docket No. 29526, March 2004 (direct) and June 2004 (rebuttal), in regard to the effect of Genco separation agreements and financial practices on stranded costs and on value of control premiums implicit in Texas Genco Stock price.

Rebuttal and additional testimony before the Illinois Commerce Commission, on behalf of Peoples Gas Light and Coke Company, Docket No. 01-0707, November 2003 (rebuttal) and January 2005 (additional rebuttal), in regard to prudence of gas contracting and hedging practices.

Rebuttal testimony before the State Office of Administrative Hearings on behalf of Texas Genco and CenterPoint Energy, Docket No. 473-02-3473, October 23, 2003, regarding proposed exclusion of part of CenterPoint's purchased power costs on grounds of including "imputed capacity" payments in price.

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Appendix B

Results of Correlation and Regression Analysis

APPENDIX B

As summarized in my report, I examined the 60 monthly observations of component availability prior to each activity (as derived by Mr. Koppe and analyzed by Dr. Rosen) and Dr. Rosen's calculations of monthly emission levels.[1] I then computed the correlation coefficient between monthly component availability and the SO_2 and NO_x emissions from the unit. Exhibit FCG-B-1 displays the results of this screening analysis.

As shown in Exhibit FCG-B-1, there is no statistically discernable linear relationship between the performance of the components in question and the emissions of the unit. During the 60 months prior to projects, the correlation coefficients between component availability and SO_2 emissions range between -0.02 and 0.28, while the correlation coefficient between component availability and NO_x emissions are between -0.15 and 0.31. Since both of these ranges are closer to zero than 1, they indicate a poor relationship between component availability and emissions. According to Dr. Rosen's method, the correlations should be positive and close to 1.0, since he believes his method conservatively describes a necessary relationship between recaptured component outages (increased EAF), generation, and emissions. As shown in the third and fourth columns in the same exhibit, the results do not change significantly if I exclude the months in which the unit in question was on outage in all hours. The correlation coefficients are still in the range of -0.02 to 0.28 for SO_2 emissions, and -0.14 to 0.31 for NO_x emissions.

[1] I used the actual estimated monthly NO_x emission levels in this analysis, not the monthly NO_x emissions that Dr. Rosen incorrectly calculates during most baseline periods. Also, I exclude the secondary superheater project at Hatfield's Ferry 2 (1999) since Mr. Koppe does not identify any outages of that component in the pre-project period.

Exhibit FCG-B-1
Correlation of 60-month Pre-Project Actuals:
Component EAF and Emissions

Plant and Project	Description	Project Year	All 60-Months Pre-Project		60-Months Excluding Outage Months		All 60-Months Excluding Outliers*	
			SO2 Emissions	*NOx Emissions*	*SO2 Emissions*	*NOx Emissions*	*SO2 Emissions*	*NOx Emissions*
Armstrong 1: Project 1	Boiler	1995	0.10	0.12	0.10	0.12	0.07	0.08
Armstrong 2: Project 1	Boiler	1994	0.24	0.24	0.24	0.24	0.18	0.15
Hatfield 1: Project 1	Secondary Superheater	1997	0.04	0.06	0.06	0.07	0.00	-0.07
Hatfield 1: Project 2	Hopper Slope	1997	0.12	-0.15	0.16	-0.14	0.14	-0.23
Hatfield 2: Project 1	Reheater	1993	-0.02	-0.02	-0.02	-0.02	0.24	0.27
Hatfield 2: Project 3	Hopper Slope	1999	0.28	0.31	0.28	0.31	0.25	0.25
Hatfield 3: Project 1	Hopper Slope	1996	0.08	-0.09	0.14	-0.07	0.06	-0.10
Mitchell 3: Project 1	Hopper Slope	1994	0.22	0.01	0.22	0.01	0.02	-0.03

Sources and Notes: All data sourced from Rosen calculations.
"n.a." indicates no component outages or derates.
Outliers defined as observations with Z-score >= |3|.
* Outlier scenario does not exclude outage months
Hatfield 2 Secondary Superheater project in 1999 is excluded from these results because there was no component outage identified in Mr. Koppe's analysis during the 60 months prior to the project start date.

I also checked to see if the results are sensitive to outliers in the variables I examined. For the purpose of identifying outliers, I used a "z-score", statistic measuring how far an observation is from its average value. Specifically, a z-score measures the number of standard deviations an observation is from the mean value of the sample. For example, the z-score for component EAF in month *m* within the 60-month sample is calculated as follows:

$$\text{z-score for month } m = (\text{EAF}_m - \text{Average EAF}) / \text{Sample Standard Deviation of EAF}$$

If the z-score of a monthly observation is greater than 3 or less than -3 (*i.e.*, more than 3 standard deviations away from its mean value), then I considered that observation as an outlier.[2] As shown in Exhibit FCG-B-1, if the outliers are excluded from analysis, the correlation coefficients are in the range of 0 to 0.24 for component availability vs. SO_2 emissions, and in the range of -0.23 to 0.27 for component availability vs. NO_x emissions. Both of these ranges still show correlation coefficients much closer to zero than 1, hence indicating a weak relationship.

In addition to the correlation analysis I just described, I also examined the statistical relationship between monthly actual emissions and component EAF for the Allegheny units during the 60 months prior to project start month by using a regression analysis. This regression analysis sheds light on whether a potential explanatory variable has any statistically significant effect on emissions, and whether it explains much of the variation in the emissions. I constructed the following simple regression model for each of SO_2 and NO_x emissions:

[2] Andersen et al., "Essentials of Statistics for Business and Economics", 2nd Edition, 2000, pages 85-88.

Emissions in month m = constant + b x Component EAF_m + error

In order to check whether component EAF has any statistically significant effect on emissions, I employed the conventional t-test. If the t-statistic for coefficient b is sufficiently low (in absolute value), then we cannot reject the hypothesis that b is zero. For large t-values, the analyst can reject that hypothesis. The regression model specified above for a 60-month sample dataset implies a threshold value of 2.0 for t-statistic at 95% significance level. In other words, if the regression results show a t-statistic for b lower than 2.0 in absolute value, this would indicate a statistically insignificant effect of Component EAF on emissions. Otherwise, we would conclude that Component EAF has a statistically significant effect on emissions.

The extent to which component EAF explains some of the variation in monthly emissions is indicated by the R-square statistic of the regression specified above. R-square of a regression is always between 0 and 1. It measures the portion of variation in the dependent variable (emissions) that the exogenous variables (component EAF in this case) can explain. An R-square value of 1 indicates that the exogenous variables explain all of the variation in dependent variable, while an R-square value of zero indicates that the exogenous variables cannot explain any portion of the variation in the dependent variable about its mean.

As shown in Exhibit FCG-B-2, the t-statistics from the regression results show that the component EAF does not have a statistically significant effect on emissions, except in the case of Project 3 in Hatfield 2 in which the t-statistic of component EAF slightly exceeds the threshold value of 2.0 at 95% significance level.

As observed in the correlation coefficients, the sign of the "b" coefficient estimating the strength of the relationship between component EAF and emissions has both positive and negative signs, when a strictly positive sign would be expected according to Dr. Rosen's theory. In all projects, the R-square of the regression is close to zero (0% to 8% in SO_2 regressions, and 0% to 9.4% in NO_x regressions). Even though the component EAF is statistically significant in the case of Project 3 in Hatfield 2, component EAF explains less than 10% of the variation in emissions.

Equivalently, over 90% of variance in emissions is explained by factors other than component EAF, *i.e.*, they are more than 9 times as important.

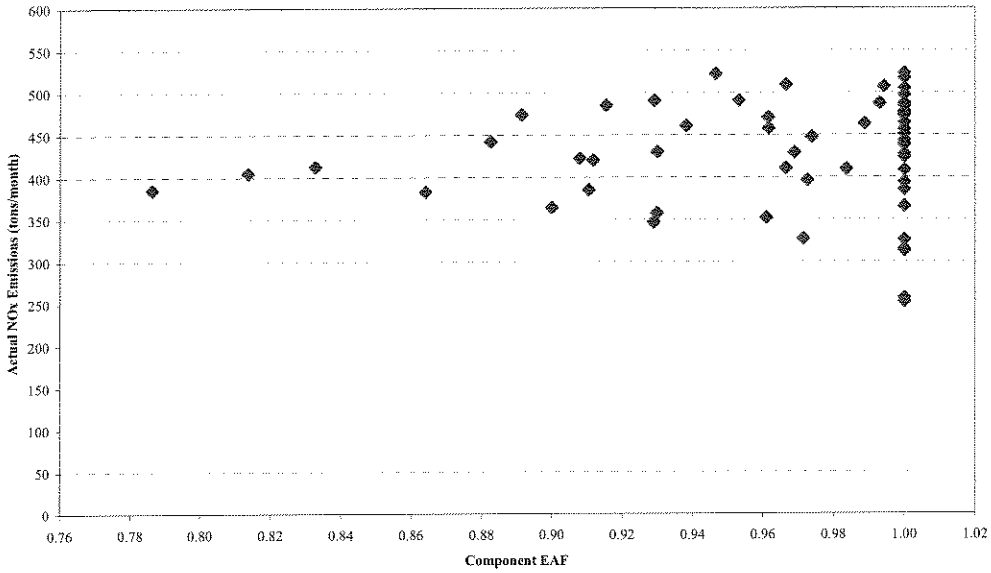
Exhibit FCG-B-2
Regression Results of Relationship Between Actual Component EAF and Emissions

Plant and Project	Description	Project Year	All 60-Months Pre-Project					
			SO2 Emissions			*NOx Emissions*		
			Estimated "b" coefficient of emissions' dependence on component EAF	*t-stat*	*R-square*	Estimated "b" coefficient of emissions' dependence on component EAF	*t-stat*	*R-square*
Armstrong 1: Project 1	Boiler	1995	417	0.73	0.9%	146	0.90	1.4%
Armstrong 2: Project 1	Boiler	1994	1154	1.87	5.7%	337	1.86	5.6%
Hatfield 1: Project 1	Secondary Superheater	1997	2290	0.32	0.2%	1402	0.49	0.4%
Hatfield 1: Project 2	Hopper Slope	1997	3627	0.92	1.4%	-1766	-1.13	2.2%
Hatfield 2: Project 1	Reheater	1993	-1056	-0.12	0.0%	-492	-0.15	0.0%
Hatfield 2: Project 3	Hopper Slope	1999	9047	2.24	8.0%	1138	2.46	9.4%
Hatfield 3: Project 1	Hopper Slope	1996	2586	0.61	0.6%	-1146	-0.67	0.8%
Mitchell 3: Project 1	Hopper Slope	1994	219	1.69	4.7%	60	0.11	0.0%

Sources and Notes: All data sourced from Rosen calculations.
"n.a." indicates no component outages or derates.
t-stats from regressions: Emissions = Constant + b x Component EAF.
A t-stat greater than 2 or less than -2 indicate that the regression coefficient is significant at 5% level of significance.
Significant t-stats are highlighted.
Component EAF is expressed as fraction of 1 (*i.e.*, it is between 0 and 1).
Hatfield 2 Secondary Superheater project in 1999 is excluded from these results because there was no component outage identified in Mr. Koppe's analysis during the 60 months prior to the project start date.

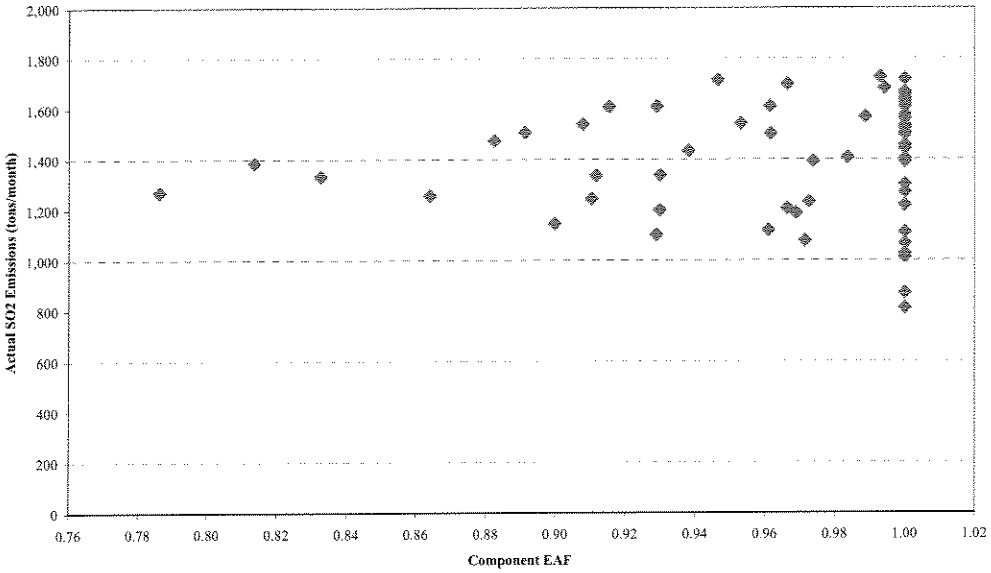
The low correlations and statistical insignificance of component EAF observed in these statistics is to be expected, since independent factors and competition with other units in the dispatch ladder are far more influential on generation than component EAF. Beyond the insignificance of the association between component availability and emissions as indicated by the statistical measures described above, a simple visual inspection of the data reveals the same insights. As shown in Exhibit FCG-B-3 through FCG-B-11, the emissions from each unit varied widely both when the components were working perfectly (component EAF equal to 100%) and also when the component experienced outages. Had there been a discernable relationship between component availability and unit emissions, I would expect to see a tighter and upward sloping pattern of observations when component EAF was less than 100%, as well as a higher concentration of monthly emissions levels at the upper right hand corner when the component EAF was 100%. Instead, there is no obvious linear relationship between component availability and emissions, as would be expected if the Plaintiffs' experts' theory was valid.

Exhibit FCG-B-3A
Component EAF and NOx Emissions: 60-month Pre-Project Actuals
Armstrong 1



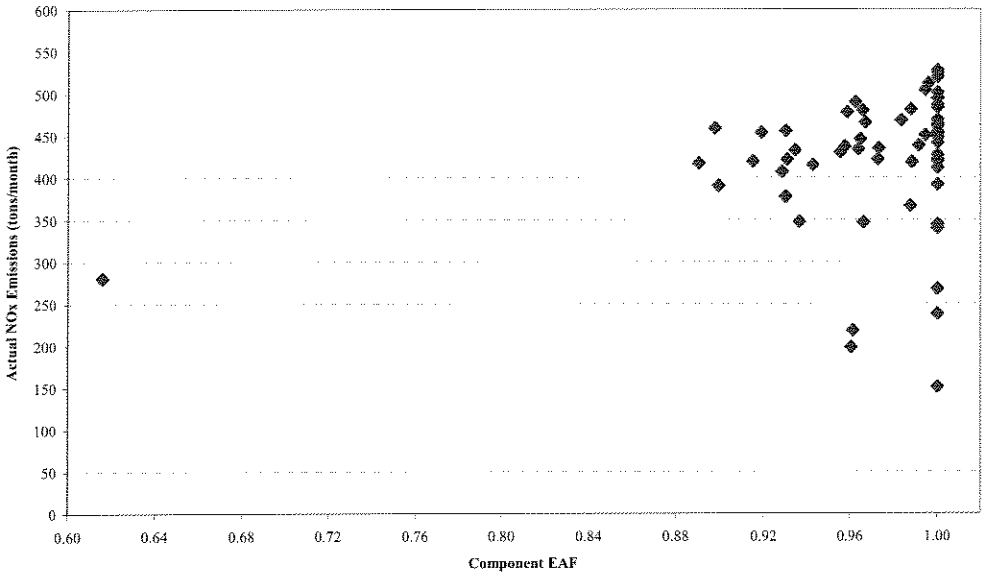
Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.

Exhibit FCG-B-3B
Component EAF and SO2 Emissions: 60-month Pre-Project Actuals
Armstrong 1



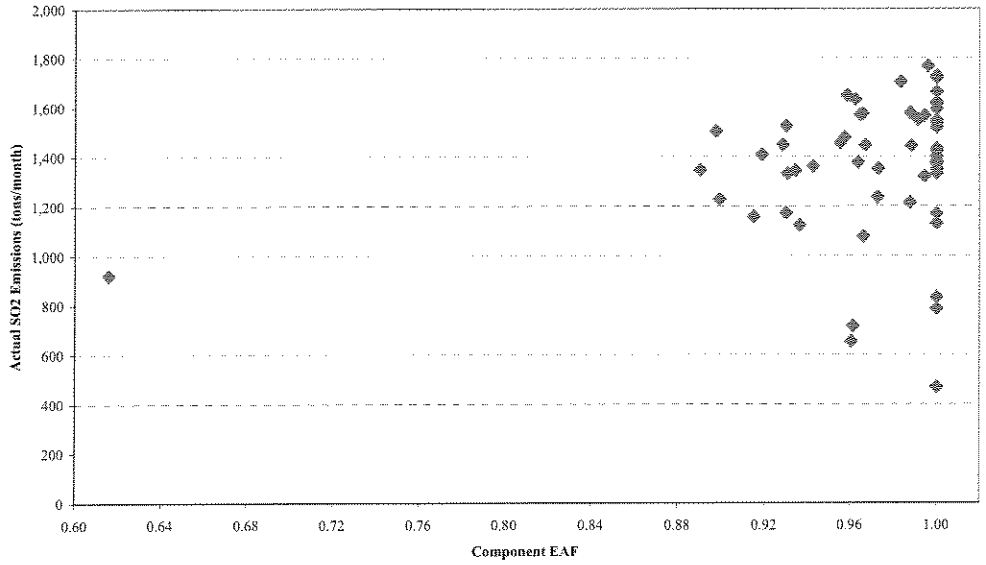
Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.

Exhibit FCG-B-4A
Component EAF and NOx Emissions: 60-month Pre-Project Actuals
Armstrong 2



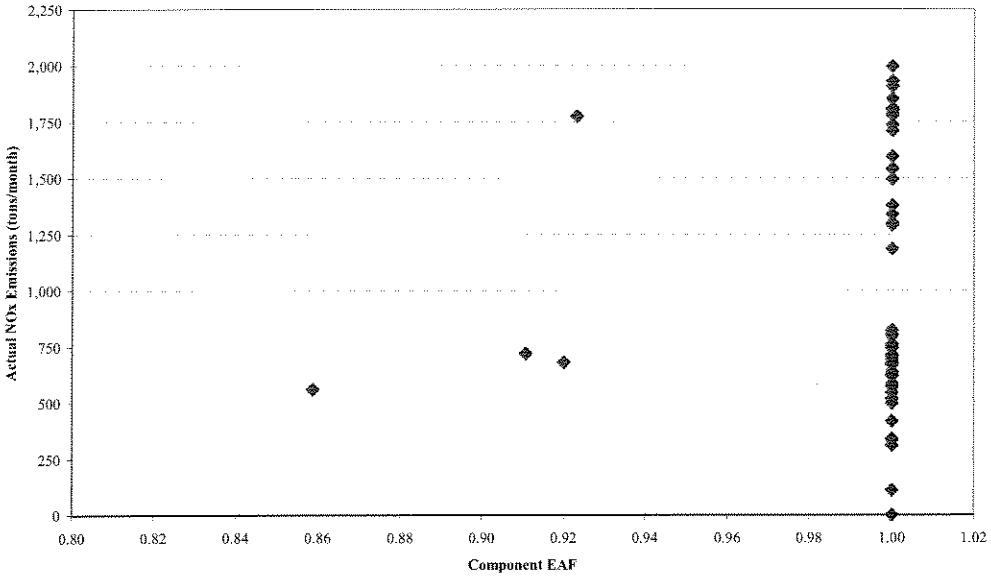
Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.

Exhibit FCG-B-4B
Component EAF and SO2 Emissions: 60-month Pre-Project Actuals
Armstrong 2



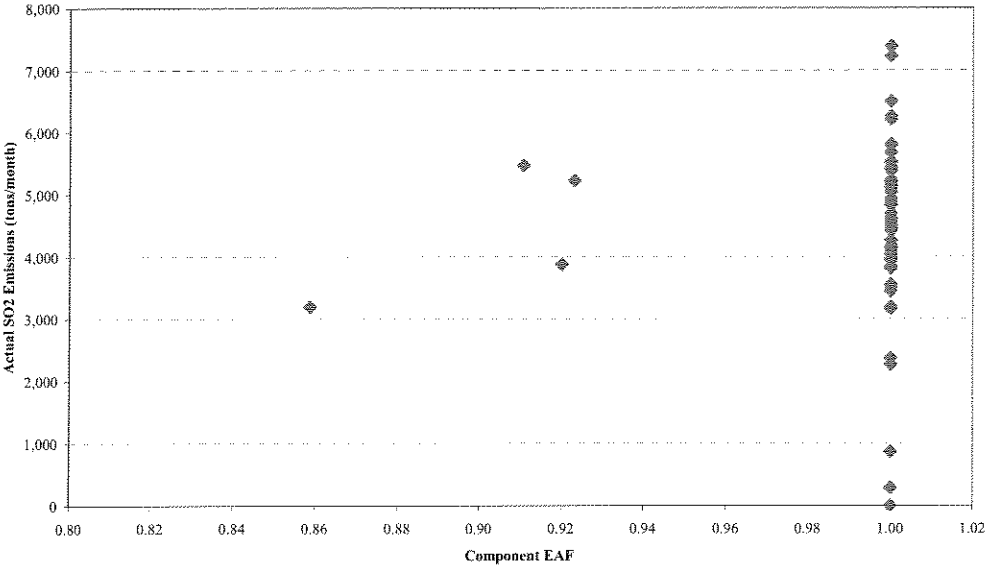
Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.

Exhibit FCG-B-5A
Component EAF and NOx Emissions: 60-month Pre-Project Actuals
Hatfield 1 - Project 1



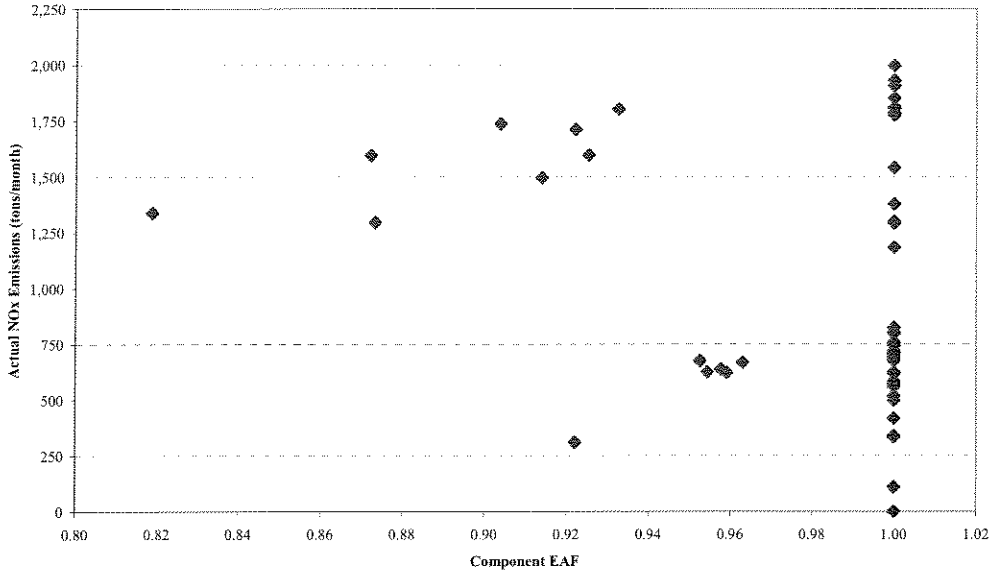
Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.

Exhibit FCG-B-5B
Component EAF and SO2 Emissions: 60-month Pre-Project Actuals
Hatfield 1 - Project 1



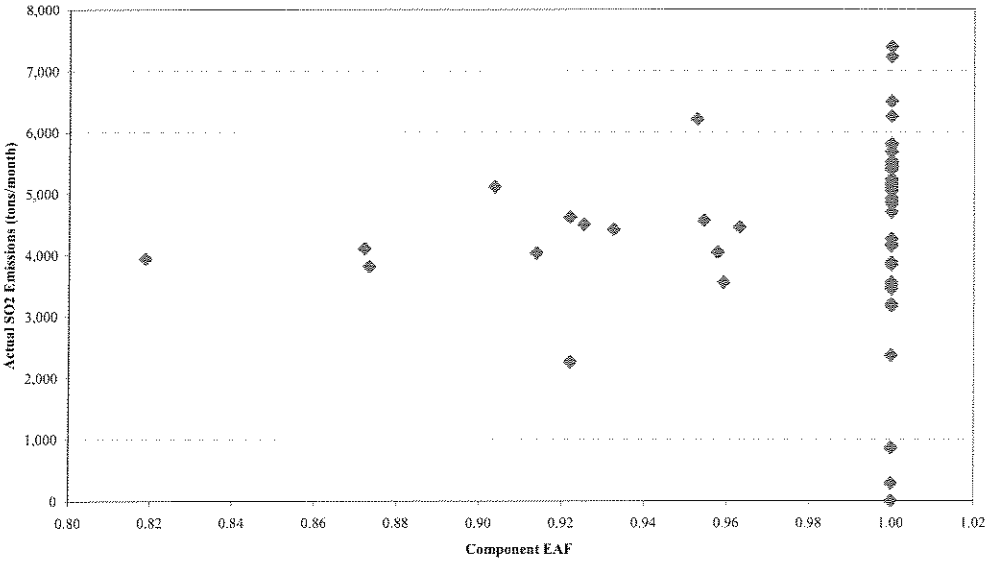
Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.

Exhibit FCG-B-6A
Component EAF and NOx Emissions: 60-month Pre-Project Actuals
Hatfield 1 - Project 2



Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.

Exhibit FCG-B-6B
Component EAF and SO2 Emissions: 60-month Pre-Project Actuals
Hatfield 1 - Project 2



Notes and Sources: All data sourced from Dr. Rosen's workpapers. Chart includes all monthly actual observations in the 60-month pre-project period.